Differential Adhesion and Socio-Evolution in Yeast

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1 Abstract

In budding yeast (*S. Cerevisiae*), the expression of "FLO genes" has been identified as a cause of flocculation in colonies. For yeast, flocculation is a protection mechanism in stress conditions. Cells expressing the FLO1 gene preferably stick to other cells that also express this gene [4]. Because they stick more strongly, $FLO1^+$ cells end up in the centre of the flocculated colony, where they are physically shielded against toxics in the medium, including ethanol and antimicrobials. From a socio-evolutionary viewpoint, FLO1 can be considered a "green beard gene", which promotes co-operation between individuals, but additionally excludes cheaters [2]. It is known that the FLO genes code for a number of surface proteins influencing intercellular interactions, but the specifics on how the cheaters are excluded are not yet fully understood.

Using the particle-based simulation software DEMeter++ [3], we created an off-lattice individual-cell based model to investigate the role of adhesion mechanics in this cell sorting phenomenon. Simulations in three dimensions show that only a difference in adhesion, caused by the expression of FLO genes, is required to create sorted colonies. In these colonies, FLO^- cells remain unattached and/or in the outer layers of the floc, and FLO^+ cells are all attached in the centre. Cell adhesion is described by the "Johnson-Kendall-Roberts"-potential, in which the attracting force is proportional to the contact area of two adhering cells [1]. The cells are modelled as suspended in liquid and move by Brownian motion. Furthermore, the effect of the budding mechanism in growing colonies on the cell sorting is being addressed.

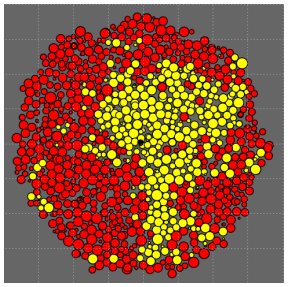

Figure 1: Slice through simulated yeast colony of ± 2e4 cells. Yellow cells are FLO+ and red cells are FLO-.

References

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